

4.0 RANGE-WIDE STATUS OF THE LISTED SPECIES

4.1 INTRODUCTION

The first step NOAA Fisheries takes when applying the ESA Section 7(a)(2) to the listed ESUs considered in this biological opinion is to define each ESU's biological requirements and evaluate its range-wide status relative to those biological requirements. Biological requirements are defined in Section 5.4. The range-wide status of each of the listed ESUs considered in this Opinion is summarized in the following sections.

4.2 LISTED SPECIES AFFECTED BY THE PROPOSED ACTION

This consultation considers whether the effects of the proposed actions are likely to jeopardize the continued existence of 12 listed and one proposed species of Columbia basin salmonids or cause the destruction or adverse modification of their designated critical habitat. The 13 species are:

- Snake River (SR) spring/summer chinook salmon (*Oncorhynchus tshawytscha*; listed as threatened on April 22, 1992 [57 FR 14653]); critical habitat designated on December 28, 1993 [58 FR 68543], and revised on October 25, 1999 [64 FR 57399].
- Snake River (SR) fall chinook salmon (*O. tshawytscha*; listed as threatened on April 22, 1992 [57 FR 14653]); critical habitat designated on December 28, 1993 [58 FR 68543].
- Upper Columbia River (UCR) spring chinook salmon (*O. tshawytscha*; listed as endangered on March 24, 1999 [64 FR 14308]); critical habitat designated on February 16, 2000 [65 FR 7764], but vacated by court order on April 30, 2002.¹
- Upper Willamette River (UWR) chinook salmon (*O. tshawytscha*; listed as threatened on March 24, 1999 [64 FR 14308]); critical habitat designated on February 16, 2000 [65 FR 7764], but vacated by court order on April 30, 2002.
- Lower Columbia River (LCR) chinook salmon (*O. tshawytscha*; listed as threatened on March 24, 1999 [64 FR 14308]); critical habitat designated on February 16, 2000 [65 FR 7764], but vacated by court order on April 30, 2002.

¹ Critical habitat had been designated for 12 of the species of salmon and steelhead considered in this opinion. However, on April 30, 2002, the United States District Court for the District of Columbia adopted a consent decree resolving the claims in National Homebuilders, *et al.* v. Evans, Civil Action No. 00-2799 (CKK)(D.D.C., April 30, 2002). Pursuant to that consent decree, the court issued an order vacating critical habitat designations for a number of listed salmonid species, including UCR spring chinook and steelhead, SR steelhead, MCR steelhead, UWR chinook and steelhead, LCR chinook and steelhead, and CR chum salmon. For this reason, the proposed action can only affect designated critical habitat for SR spring/summer chinook salmon, SR fall chinook salmon, and SR sockeye salmon. Thus, this opinion will not determine whether the proposed action is likely to result in the destruction or adverse modification of any critical habitat for 10 of 13 ESUs.

- Snake River (SR) steelhead (*O. mykiss*); listed as threatened on August 18, 1997 ([62 FR 43937]); critical habitat designated on February 16, 2000 [65 FR 7764], but vacated by court order on April 30, 2002.
- Upper Columbia River (UCR) steelhead (*O. mykiss*); listed as endangered on August 18, 1997 [62 FR 43937]; critical habitat designated on February 16, 2000 [65 FR 7764], but vacated by court order on April 30, 2002.
- Middle Columbia River (MCR) steelhead (*O. mykiss*); listed as threatened on March 25, 1999 [64 FR 14517]; critical habitat designated on February 16, 2000 [65 FR 7764], but vacated by court order on April 30, 2002.
- Upper Willamette River (UWR) steelhead (*O. mykiss*); listed as threatened on March 25, 1999 [64 FR 14517]; critical habitat designated on February 16, 2000 [65 FR 7764], but vacated by court order on April 30, 2002.
- Lower Columbia River (LCR) steelhead (*O. mykiss*); listed as threatened on March 19, 1998 [63 FR 13347]; critical habitat designated on February 16, 2000 [65 FR 7764], but vacated by court order on April 30, 2002.
- Columbia River (CR) chum salmon (*O. keta*); listed as threatened on March 25, 1999 [64 FR 14508]; critical habitat designated on February 16, 2000 [65 FR 7764], but vacated by court order on April 30, 2002.
- Snake River (SR) sockeye salmon (*O. nerka*); listed as endangered on November 20, 1991 [56 FR 58619]; critical habitat designated on December 28, 1993 [58 FR 68543].
- Lower Columbia River coho salmon (*O. kisutch*); proposed for listing as threatened on June 14, 2004 [69 FR 33102].

On June 14, 2004, NOAA Fisheries published its proposed ESU listing determinations for Pacific salmon and steelhead in the Federal Register in response to the *Alsea* decision (hereafter “2004 Status Review,” Section 2.1.3). Of the 12 ESUs considered in the 2000 Opinion, NOAA Fisheries has proposed a change in status only for UCR steelhead (from endangered to threatened). Also, NOAA Fisheries proposes to add over 100 hatchery populations and resident populations of *O. mykiss*.

The June 14, 2004 Federal Register Notice also included a proposal to list Lower Columbia River (LCR) coho salmon (*O. kisutch*) as threatened. The ESA requires that the Action Agencies confer with NOAA Fisheries on any agency action that is likely to jeopardize the continued existence of any species proposed to be listed or result in the destruction or adverse modification of critical habitat proposed to be designated for such species (ESA § 7(a)(4)). As indicated, with one exception, NOAA Fisheries is proposing a revision to a current listing rather than a new listing proposal. The Action Agencies have requested consultation on the current listings. They have not requested conferencing on the revision, and NOAA Fisheries concurs that conferencing is not required in addition to the present consultation on the existing listings. For the one ESU

that NOAA Fisheries is presently proposing to list (Lower Columbia River coho), a conference is similarly unnecessary, given that the Opinion concludes that the proposed action is not likely to jeopardize the continued existence of this ESU.

Although the listing determinations will not be finalized until after the period of this remand, NOAA Fisheries uses the same information in this chapter as in the proposed listing determinations, because this is currently the best available scientific and commercial information on range-wide status.

4.3 CURRENT RANGE-WIDE STATUS OF LISTED SPECIES AFFECTED BY THE PROPOSED ACTION

Before NOAA Fisheries assesses the current status of the listed species within the action area, it reviews the reasons it decided that those species should be listed for ESA protection. It also considers any new data relevant to those determinations. The listing status, general life history, and population dynamics of each species are described in detail in the 2004 Status Review. These data are summarized in the following sections, along with more recent dam and spawner counts for the years after 2001, where available, and updated population trends.

Consideration of Recent Ocean Conditions in the Listing Determinations

In the last decade, evidence has shown recurring, decadal-scale patterns of ocean-atmosphere climate variability in the North Pacific Ocean. These oceanic productivity “regimes” have correlated with salmon population abundance in the Pacific Northwest and Alaska. Survival rates in the marine environment are strong determinants of population abundance for Pacific salmon and steelhead. However, because the confidence with which ocean-climate regimes can be predicted into the future is limited, man’s ability to project the future influence of ocean-climate conditions on salmonid productivity is limited. Even under the most optimistic scenario, increases in abundance might be only temporary and could mask a failure to address underlying factors for decline. It is reasonable to assume that salmon populations have persisted over time under pristine conditions through many such cycles in the past. Less certain is how the populations will fare in periods of poor ocean survival when their freshwater, estuary, and nearshore marine habitats are degraded.

4.3.1 SR Spring/summer Chinook Salmon

4.3.1.1 ESU Structure

Based on genetic and geographic considerations, the Interior Technical Review Team (TRT 2003) established five major population groups in this ESU: the Lower Snake River Tributaries, the Grande Ronde and Imnaha rivers, the South Fork Salmon River, the Middle Fork Salmon River, and the upper Salmon River. The Interior TRT further subdivided these groupings into a total of 31 extant, demographically independent populations (Appendix B, Figure B.1). However, chinook salmon have been extirpated from the Snake River and its tributaries above Hells Canyon Dam, an area that encompassed about 50% of the pre-European spawning areas in the Snake River basin (NRC 1996). Major subbasins in the Clearwater were blocked to chinook

in 1927 by the Lewiston Dam. Although the number of spring-run spawning aggregations that were lost due to construction of the Snake River mainstem dams is unknown, the ESU still has a wide spatial distribution in a variety of locations and habitat types.

4.3.1.2 The BRT Findings

NOAA Fisheries recently conducted a status review of the SR spring/summer chinook salmon and other ESUs. As part of that status review, NOAA Fisheries convened a Biological Review Team (BRT) to evaluate the available scientific data. The BRT analysis included dam counts and spawner returns for natural-origin fish through 2001. As indicated in Section 1.0, NOAA Fisheries must examine the criteria for a sufficient number and distribution of viable salmonid populations (VSP) in order to assess the range-wide biological requirements of the ESU. The BRT did the same thing in assessing whether or not the ESU should be listed as an endangered or threatened species. In this case, the BRT found that, compared to the levels needed for a healthy species, there was a moderately high risk that the abundance and productivity criteria were not currently being met and a low risk that the spatial structure and diversity criteria were not currently being met. Concerns regarding diversity were somewhat alleviated, because out-of-ESU Rapid River broodstock had been phased out of the Grande Ronde. Despite the recent positive signs, the BRT still felt that the ESU was at some level of risk.

4.3.1.3 2004 Status Review

An indicator of the current range-wide status of this ESU is the number of spawners returning to natural production areas. In 1995, NOAA Fisheries established abundance levels for natural production areas that would be indicative of a recovered population (NMFS 1995), and these levels were updated as “interim abundance and productivity targets” in 2002 (NMFS 2002b). Many, but not all of the 29 extant natural production areas within this ESU have experienced large increases in the number of returning spawners in the last 2 to 3 years, with two populations (Grande Ronde and Imnaha) nearing the previously specified recovery abundance levels. Due to the severe declines in the populations since the 1960s and the short-term nature of the recent high returns, long-term productivity trends remain below replacement for all natural production areas, despite the recent increases. However, the short-term productivity trends for the majority of the natural production areas in the ESU are at or above replacement, which is a positive sign.

During the Status Review, NOAA Fisheries evaluated whether conservation efforts, such as the extensive artificial propagation program within this ESU reduced or eliminated the risk to SR spring/summer chinook. In performing this analysis, NOAA Fisheries was guided by the NMFS/USFWS “Policy for Evaluation of Conservation Efforts When Making Listing Decisions” (“PECE”; 68 FR 15100; March 28, 2003). NOAA Fisheries concluded that the artificial propagation programs did provide benefits to the ESU in terms of abundance, spatial structure, and diversity but that the programs had neutral or uncertain effects in terms of overall ESU productivity. As a result, NOAA Fisheries did not believe that the artificial propagation programs were sufficient to substantially reduce the long-term extinction risk of the ESU. Thus, even though the ESU is likely to benefit from strong upcoming brood years², NOAA Fisheries

² That is, the upcoming brood years were derived from strong spawning escapements and improved conditions during the ocean phase of the life cycle.

proposed to retain the current listing of this species as threatened (i.e., likely to become an endangered species within the foreseeable future). Actions under the 2000 FCRPS Biological Opinion and improvements in hatchery practices are addressing some of the ESU's factors for decline.

4.3.1.4 Recent Dam Counts and Returns to the Spawning Grounds

Cooney (2004) updated the spawner count data used by the BRT (2003) for use by the Interior Columbia Basin Technical Recovery Team, adding data for 2002 and 2003, which he requested from the Comanagers. In general, for most of the 24 populations where recent data were available, indices of abundance (i.e., redd counts) for natural-origin SR spring/summer chinook were high in 2002 and 2003 compared to the 1990s. Fisher and Hinrichsen (2004) provided a preliminary evaluation of the effects of recent natural-origin spring chinook returns on past geometric mean abundance levels and population trends. The latter were calculated as the slope of the regression line for the (log transformed) index of abundance over time. They assessed whether the geomean was greater when calculated from the most recent data (beginning in 2001) compared to a base period (1996-2000) and whether the trend was greater when counts for 2001-2003 were added to the 1990-2000 data series. Their methods were taken from those used by NOAA Fisheries' BRT (2003). The geomean for 2001-2003 (33,581) exhibited a 548% increase over the 1996-2000 base period (5,186 fish). The slope of the trend for the natural-origin population increased 17% (from 0.97 to 1.14) when the data for 2001-2003 were added to the 1990-2000 series, reversing the decline and indicating that, at least for the short-term, the natural-origin population has been increasing. Hatchery fish constituted 69% of the return during the recent period compared to an average of 60% during 1990-2000 (Fisher 2004). Even so, natural-origin fish exhibited the substantial increase in numbers described above. Neither the BRT nor the Interior TRT has reviewed Fisher and Hinrichsen (2004) or Fisher (2004).

4.3.2 SR Fall Chinook Salmon

4.3.2.1 ESU Structure

A majority of the fish in this ESU spawn in the mainstem Snake River between the head of Lower Granite Reservoir and Hells Canyon Dam, with the remaining fish distributed among lower sections of the major tributaries (Connor *et al.* 2002). Fish in the mainstem Snake appear to be distributed in a series of aggregates from the mouth of Asotin Creek to River Mile (RM) 219, although smaller numbers have been reported spawning in the tailraces of the Lower Snake dams (Connor *et al.* 1993; Dauble *et al.* 1995). Due to their proximity and the likelihood that individual tributaries could not support a sufficiently large population, the Interior TRT (TRT 2003) considered these aggregates and the associated reaches in the lower major tributaries to the Snake to be a single population (Appendix B, Figure B.2). This is consistent with past practice in prior biological opinions.

Before European impact, Snake River fall chinook salmon are believed to have once occupied and spawned in the mainstem Snake River from its confluence with the Columbia river upstream to Shoshone Falls (RM 615). The spawning grounds between Huntington, Oregon (RM 328) and Auger Falls in Idaho (RM 607) were historically the most important for this species. Historically, only limited spawning activity occurred downstream of RM 273 (Waples *et al.* 1991), which is

about one mile below Oxbow Dam. However, development of irrigation and hydropower projects on the mainstem Snake River have inundated or blocked access to most of this area in the past century. Construction of Swan Falls Dam (RM 458) in 1901 eliminated access to 157 miles (about 25%) of total potential habitat, leaving 458 miles of habitat. Construction of the Hells Canyon Dam complex (1958-1967) cut off anadromous fish access to 211 miles (or 46%) of the remaining historical fall chinook habitat upstream of RM 247. Additional fall chinook habitat was lost through inundation as a result of the construction of the four lower mainstem Snake River dams. Currently, SR fall chinook salmon have access to approximately 100 miles of mainstem Snake River habitat, which is roughly 22% of the 458 miles of historic habitat available prior to completion of the Hells Canyon Complex and the four lower Snake River dams. Historical use of habitat in the Clearwater River is uncertain. Tiffan *et al.* (2001) concluded that there was “no conclusive evidence” whether the lower Clearwater River supported the basin subyearling migrant life-history pattern associated with Snake River fall chinook.

4.3.2.2 The BRT Findings

Approximately 80% of historical spawning habitat was lost with the construction of a series of dams on the mainstem Snake River. The loss of spawning habitat, restricting the extant ESU to a single naturally spawning population, increased the ESU’s vulnerability to environmental variability and catastrophic events. The diversity associated with populations that once resided above the Snake River dams has been lost, and the impact of out-of-ESU fish straying to the spawning grounds has the potential to further compromise the genetic diversity of the ESU. Although recent improvements in the marking of out-of-ESU hatchery fish and their removal at Lower Granite Dam have reduced the impact of these strays, introgression below Lower Granite Dam remains a concern. The BRT found moderately high risk for all VSP categories and therefore felt that, despite the recent positive signs, the ESU was at some level of risk.

4.3.2.3 2004 Status Review

During the Status Review, NOAA Fisheries evaluated whether artificial propagation programs within this ESU reduce or eliminate risks to its viability, guided by the PECE policy (Section 4.3.1). NOAA Fisheries concluded that the artificial propagation programs have provided benefits to the ESU in terms of abundance, spatial distribution, and diversity in recent years, although the contribution of these programs to overall ESU productivity is uncertain and the artificial propagation programs are not sufficient to substantially reduce the long-term risk of extinction. Depending upon the assumption made about the likelihood of the progeny of hatchery fish returning as productive adults, long- and short-term trends in productivity are at or above replacement. Thus, NOAA Fisheries proposed to retain the current listing of this species as threatened (i.e., likely to become an endangered species within the foreseeable future) even though it is not likely to go extinct in the near future. Actions under the 2000 FCRPS Biological Opinion and improvements in hatchery practices have provided some encouraging signs in addressing the ESU’s factors for decline.

4.3.2.4 Recent Dam Counts and Returns to the Spawning Grounds

Cooney (2004) reported that the high counts of natural-origin SR fall chinook continued in 2002 and 2003 (2,114 and 3,896 adults at Lower Granite Dam, respectively). In their preliminary analysis of recent returns, Fisher and Hinrichsen (2004) reported that the geometric mean abundance of naturally-produced fall chinook was 3,462 during 2001-2003, compared to 694 in 1996-2000 (a 398% increase). The slope of the population trend increased 8.0% (from 1.16 to 1.24) when the data for 2001-2003 were added to the 1990-2000 series. These results indicate that at least for the short-term, the population has been increasing. Approximately 64% of the aggregate run at Lower Granite Dam was hatchery fish in 2001-2003, compared to 67% during 1990-2000 (Fisher 2004).

4.3.3 UCR Spring Chinook Salmon

4.3.3.1 ESU Structure

The Interior TRT (TRT 2003) identified one major population group consisting of three demographically independent populations in the UCR spring chinook ESU (Appendix B, Figure B.3). Due to the relatively small size of the area, they did not identify any major groupings. Within the current boundary of the ESU, spring chinook are considered extirpated from the Okanogan drainage. The historical status of spring-run, stream-type fish belonging to this ESU in the Okanogan is uncertain. The Interior TRT could not determine definitively whether an independent population of UCR spring chinook existed there in the past but recognized the possibility that the area may have supported one. The construction of Grand Coulee Dam in 1939 blocked access to over 50% of the river miles formerly available to UCR spring chinook (NRC 1996). Tributaries in this blocked area may have supported one or more populations, but the lack of data on distribution and genetic makeup made it impossible for the Interior TRT to make any definitive determination.

4.3.3.2 The BRT Findings

The five hatchery spring-run chinook populations considered to be part of this ESU are programs aimed at supplementing natural production areas. These programs have contributed substantially to the abundance of natural spawners in recent years. However, little information is available to assess the impact of these high levels of supplementation on the long-term productivity of natural populations. The BRT (2003) concluded that spatial structure in this ESU was of little concern, because there is passage and connectivity among almost all populations. During years of critically low escapement (1996 and 1998), extreme management measures were taken in one of the three major spring chinook producing basins where all returning adults were collected and taken into the hatchery supplementation programs, reflecting the ongoing vulnerability of certain segments of this ESU. The BRT expressed concern that these actions, while appropriately guarding against the catastrophic loss of populations, may have compromised ESU population structure and diversity. The BRT's assessment of risk for the four VSP categories reflects strong concerns regarding abundance and productivity and comparatively less concern for ESU spatial structure and diversity (BRT 2003).

4.3.3.3 2004 Status Review

In its Status Review, NOAA Fisheries' assessment of the effects of artificial propagation concluded that the within-ESU hatchery programs do not substantially reduce the extinction risk of the ESU in-total (NMFS 2004b). Protective efforts, as evaluated pursuant to the PECE, did not alter NOAA Fisheries' assessment that the ESU is in danger of extinction or likely to become so in the foreseeable future. Actions under the 2000 FCRPS Biological Opinion, Federally-funded habitat restoration efforts, and other protective efforts are encouraging signs in addressing the ESU's factors for decline, but they do not as yet substantially reduce the ESU's extinction risk. Artificial propagation practices within the geographic range of the ESU do not fully support the conservation and recovery of UCR spring-run chinook. In particular, NOAA Fisheries is concerned that the non-ESU Entiat National Fish Hatchery has compromised the genetic integrity of the native natural population of spring-run chinook in the Entiat basin.

4.3.3.4 Recent Dam Counts and Returns to the Spawning Grounds

Cooney (2004) reported that natural-origin returns to the Methow subbasin in 2002 and to the Entiat and Wenatchee during 2002 and 2003 continued to exceed those observed during much of the 1990s. However, returns to the Methow declined during 2003. In their preliminary analysis, Fisher and Hinrichsen (2004) reported that the geometric mean of aggregate numbers of UCR spring chinook salmon increased 1,038% from 1996-2000 (4,959) to 2001-2003 (436 fish). The slope of the aggregate population trend increased 9.3% (from 1.00 to 1.10) when the data for 2001-2003 were added to the 1990-2000 series. These results indicate that, at least in the short-term, the aggregate population and the natural-origin populations in the Entiat and Wenatchee subbasins have been increasing.

4.3.4 UWR Chinook Salmon

4.3.4.1 ESU Structure

The Willamette/Lower Columbia River (W/LC) TRT (McElhany *et al.* 2004) identified seven demographically independent populations of UWR chinook salmon in a single major group (Appendix B, Figure B.4). All of these populations are extant, although they vary in degree of viability.

4.3.4.2 The BRT Findings

Numbers passing Willamette Falls have remained relatively steady over the past 50 years (ranging from approximately 20,000 to 75,000), but are an order of magnitude below the peak abundance levels observed in the 1920s (approximately 300,000 adults). The Clackamas and McKenzie river populations have shown substantial increases in total abundance since 2000. Trends in the other populations are difficult to determine. However, interpretation of the difference in abundance levels for the other populations remains confounded by a high but uncertain fraction of hatchery-origin fish.

The BRT estimated that, despite improving trends in total productivity since 1995, productivity would be below replacement in the absence of artificial propagation. The BRT was particularly concerned that a majority of the historical spawning habitat and approximately 30 to 40% of total historical habitat are now inaccessible behind dams. The restriction of natural production to just a few areas increases the ESU's vulnerability to environmental variability and catastrophic events. Losses of local adaptation and genetic diversity through the mixing of hatchery stocks within the ESU and the introgression of out-of-ESU hatchery fall-run chinook represent threats to ESU diversity. However, the BRT was encouraged by the recent closure of the fall-run hatchery and by improved marking rates of hatchery fish to assist in monitoring and in the management of a marked-fish selective fishery. The BRT found moderately high risks for all VSP categories.

4.3.4.3 2004 Status Review

There are no direct estimates of total natural-origin spawner abundance for the UWR chinook ESU. The abundance of the aggregate run passing Willamette Falls has remained relatively steady over the past 50 years (ranging from approximately 20,000 to 70,000 fish), but is only a fraction of peak abundance levels observed in the 1920s (approximately 300,000 adults). Interpretation of abundance levels is confounded by a high but uncertain fraction of hatchery produced fish. The McKenzie River population has shown substantial increases in total abundance (hatchery origin and natural origin fish) in the last 2 years, while trends in other natural populations in the ESU are generally mixed. With the relatively large incidence of hatchery fish spawning in the wild, it is difficult to determine trends in productivity for natural-origin fish.

Seven artificial propagation programs in the Willamette River produce fish that are considered to be part of the UWR chinook salmon ESU. All of these programs are funded to mitigate for lost or degraded habitat and produce fish for harvest purposes. During the Status Review, NOAA Fisheries' assessment of the effects of artificial propagation concluded that these hatchery programs collectively do not substantially reduce the extinction risk of the ESU (NMFS 2004b). An increasing proportion of hatchery-origin returns has contributed to increases in total ESU abundance. However, it is unclear whether these returning hatchery and natural fish actually survive over winter to spawn. Estimates of pre-spawning mortality indicate that a high proportion (more than 70%) of spring chinook in most ESU populations die before spawning. In recent years, hatchery fish have been used to reintroduce spring chinook back into historical habitats above impassible dams (e.g., in the North Santiam, McKenzie, and Middle Fork Willamette rivers), slightly decreasing risks to ESU spatial structure. Within-ESU hatchery fish exhibit different life-history characteristics from natural ESU fish. High proportions of hatchery-origin natural spawners in remaining natural production areas (i.e., in the Clackamas and McKenzie rivers) may thereby have negative impacts on within- and among-population genetic and life-history diversity. Collectively, artificial propagation programs in the ESU have a slight beneficial effect on ESU abundance and spatial structure but neutral or uncertain effects on ESU productivity and diversity. Protective efforts, as evaluated pursuant to the PECE, did not alter the assessments of the BRT and the Artificial Propagation Evaluation Workshop participants that the ESU is "likely to become endangered within the foreseeable future." The USFWS Greenspaces Program, the Oregon Plan, hatchery reform efforts, and other protective initiatives are

encouraging signs. However, restoration efforts in the ESU are very local in scale and have yet to provide benefits at the scale of watersheds or at the larger spatial scale of the ESU. The blockage of historical spawning habitat and the restriction of natural production areas remain to be addressed.

4.3.4.4 Recent Dam Counts and Returns to the Spawning Grounds

Fisher and Hinrichsen (2004) report that the preliminary geometric mean aggregate abundance of UWR chinook salmon in the Clackamas and McKenzie rivers is equal to 12,530 for 2001-2003 compared to 3,041 in 1996-2000, a 312% increase. The slope of the aggregate population trend increased 15.2% (from 0.89 to 1.02) when the data for 2001-2003 were added to the 1990-2000 series, reversing the decline and indicating that, at least in the short-term, the aggregate population has been increasing..

4.3.5 LCR Chinook Salmon

4.3.5.1 ESU Structure

The W/LC TRT (McElhany *et al.* 2004) identified a total of 23 extant, demographically independent populations in six major population groups: the Coastal Fall-run, Cascade Fall-run, Cascade Late Fall-run, Cascade Spring-run, Gorge Fall-run, and Gorge Spring-run (Appendix B, Figures B.5a and B.5b).

4.3.5.2 The BRT Findings

Abundance estimates of naturally produced spring chinook have improved since 2001 due to the marking of all hatchery spring chinook releases (compared to a previous marking rate of only 1 to 2%), which allows for the separation in counts at weirs and traps and on spawning grounds. Despite recent improvements, long-term trends in productivity are below replacement for the majority of populations. Of the historical populations, 8 to 10 have been extirpated or nearly extirpated. Although approximately 35% of historical habitat has been lost behind impassable barriers, the ESU exhibits a broad spatial distribution in a variety of watersheds and habitat types. Natural production currently occurs in approximately 20 populations, although only one population has a mean spawner abundance exceeding 1,000 fish.

The BRT expressed concern that most of the extirpated populations are spring-run, and the disproportionate loss of this life history type represents a risk to ESU diversity. Additionally, of the four hatchery spring-run chinook populations considered to be part of the ESU, two are propagated in rivers that, although they are within the historical geographic range of the ESU, probably did not support spring-run populations. High hatchery production poses genetic and ecological risks to the natural populations and complicates assessments of their performance. The BRT also expressed concern over the introgression of out-of-ESU hatchery stocks. The BRT found moderately high risk for all VSP categories.

4.3.5.3 2004 Status Review

In its Status Review, NOAA Fisheries notes that many populations within the LCR chinook ESU have exhibited pronounced increases in abundance and productivity in recent years, possibly due to improved ocean conditions. Abundance estimates of naturally-spawned populations have been uncertain until recently due to a high (approximately 70%) fraction of naturally spawning hatchery fish. Abundance estimates of naturally-produced spring chinook have improved since 2001 due to the marking of all hatchery spring chinook releases (compared to a previous marking rate of only 1 to 2%), which allows for the separation in counts at weirs and traps and on spawning grounds. Despite recent improvements, long-term trends in productivity through 2001 were below replacement for the majority of populations in the ESU. Of the historical populations, 8 to 10 were extirpated or nearly extirpated. Although approximately 35% of historical habitat is behind impassable barriers, the ESU exhibits a broad spatial distribution in a variety of watersheds and habitat types. Natural production occurs in approximately 20 populations, although as of 2001, only one population had a mean spawner abundance exceeding 1,000 fish.

Seventeen artificial propagation programs releasing hatchery chinook salmon are considered part of the LCR chinook ESU. All of these programs are designed to produce fish for harvest, and three of these programs are also intended to augment naturally spawning populations in the basins where the fish are released. These three programs integrate naturally produced spring chinook salmon into the broodstock in an attempt to minimize the genetic effects of returning hatchery adults that spawn in the wild.

During the 2004 Status Review, NOAA Fisheries' assessment of the effects of artificial propagation concluded that these hatchery programs do not substantially reduce the extinction risk of the ESU in-total (NMFS 2004b). Although the hatchery programs have been successful at producing substantial numbers of fish, thereby reducing risks to ESU abundance, their effect on the productivity of the ESU in-total is uncertain. Additionally, the high level of hatchery production in this ESU poses potential genetic and ecological risks to the ESU and confounds the monitoring and evaluation of abundance trends and productivity. The Cowlitz River spring chinook salmon program releases parr into the upper Cowlitz River basin in an attempt to reestablish a naturally spawning population above Cowlitz Falls Dam. Such reintroduction efforts increase the ESU's spatial distribution into historical habitats and slightly reduce risks to ESU spatial structure. The few programs that regularly integrate natural fish into the broodstock may help preserve genetic diversity within the ESU. However, the majority of hatchery programs in the ESU have not converted to the practice of regularly incorporating natural broodstock, thus limiting this risk-reducing feature at the ESU scale. Past and ongoing transfers of broodstock among hatchery programs in different basins represent risks to within- and among-population diversity. Collectively, artificial propagation programs in the ESU provide slight benefits to ESU abundance, spatial structure, and diversity but have neutral or uncertain effects on productivity.

NOAA Fisheries' assessment of the effects of artificial propagation concluded that the within-ESU hatchery programs do not substantially reduce the risk of the ESU in-total (NMFS 2004b). Protective efforts, as evaluated pursuant to the PECE, did not alter NOAA Fisheries' assessment that the ESU is "likely to become endangered within the foreseeable future." Planned dam

removals on the Sandy River, Federally funded habitat restoration efforts, the Washington Department of Natural Resources Habitat Conservation Plan, and other protective efforts are encouraging signs that the ESU's factors for decline are being addressed, but they do not as yet substantially reduce threats to the ESU.

4.3.5.4 Recent Dam Counts and Returns to the Spawning Grounds

Fisher and Hinrichsen (2004) compared the aggregate abundance of 41,450 during 2001 to a geomean of 11,135 for the years 1996-2000, a 272% increase. The slope of the aggregate population trend increased 6.6% (from 0.76 to 1.03) when the count for 2001 was added to the 1990-2000 data series, reversing the decline and indicating that, at least in the short-term, the aggregate population is increasing.

4.3.6 SR Steelhead

4.3.6.1 ESU Structure

The Interior TRT (TRT 2003) identified 23 populations³ in six major population groups in this ESU: the Clearwater River, the Grande Ronde River, Hells Canyon, the Imnaha River, the Lower Snake River, and the Salmon River (Appendix B, Figure B.6). Like SR spring/summer chinook salmon, SR steelhead were blocked from portions of the upper Snake River beginning in the late 1800s and culminating with the construction of Hells Canyon Dam in the 1960s.

The SR steelhead ESU includes all naturally spawned populations of steelhead (and their progeny) in streams in the Snake River basin of southeast Washington, northeast Oregon, and Idaho (62 FR 43937; August 18, 1997).

NOAA Fisheries' June 14, 2004 listing proposal did not resolve the ESU membership of native resident populations that are above recent (usually man-made) impassable barriers but below natural barriers. It was provisionally proposed that these resident populations not be considered part of the revised SR steelhead ESU until such time as significant scientific information becomes available to afford a case-by-case evaluation of their ESU relationships. There was one exception in the listing proposal: recent genetic data suggest that native resident steelhead above Dworshak Dam on the North Fork Clearwater River are part of the ESU. However, NOAA Fisheries did not propose that hatchery rainbow trout introduced to the Clearwater River (and other areas within the ESU) be included in the ESU. The presence of six major population groups in this ESU means that it is less likely that any single group is significant for this ESU's survival and recovery, compared to ESUs with fewer major population groups.

³ The Interior TRT (2003) identified one additional group of tributaries, Hells Canyon, which members thought was not large enough to support a demographically independent population.

4.3.6.2 The BRT Findings

The BRT (2003) noted that the ESU remains spatially well distributed in each of the six major geographic areas in the Snake River basin. However, the Snake River basin steelhead “B run”⁴ was particularly depressed. The BRT was also concerned about the predominance of hatchery-origin fish in this ESU, the inferred displacement of naturally produced fish by hatchery-origin fish, and potential impacts on ESU diversity. High straying rates exhibited by some hatchery programs generated concern about the possible homogenization of population structure and diversity. However, recent efforts to improve the use of local broodstock and release hatchery fish away from natural production areas are encouraging. For many BRT members, the presence of relatively numerous resident fish reduces risks to ESU abundance but provides an uncertain contribution to ESU productivity, spatial structure, and diversity (NMFS 2003b; 2004a). The BRT found moderate risk for the abundance, productivity, and diversity VSP categories and comparatively lower risk in the spatial structure category.

4.3.6.3 2004 Status Review

The paucity of information on adult spawning escapement for specific tributary production areas in the SR steelhead ESU made a quantitative assessment of viability difficult. Annual return estimates are limited to counts of the aggregate return over Lower Granite Dam, and spawner estimates for the Tucannon, Grande Ronde, and Imnaha Rivers. The 2001 return over Lower Granite Dam was substantially higher relative to the low levels seen in the 1990s; the recent 5-year mean abundance (14,768 natural returns) approximately 28% of the interim recovery target level. The abundance surveyed in sections of the Grande Ronde Imnaha and Tucannon Rivers was generally improved in 2001. However, recent 5-year abundance and productivity trends (through 2001) were mixed. Five of the nine available data series exhibit positive long- and short-term trends in abundance. The majority of long-term population growth rate estimates for the nine available series were below replacement. The majority of short-term population growth rates (through 2001) were marginally above replacement or well below replacement, depending upon the assumption made regarding the effectiveness of hatchery fish in contributing to natural production.

There are six artificial propagation programs producing steelhead in the Snake River basin that are considered to be part of the ESU. Artificial propagation enhancement efforts occur in the Imnaha River (Oregon), Tucannon River (Washington), East Fork Salmon River (Idaho, in the initial stages of broodstock development), and South Fork Clearwater River (Idaho). In addition, Dworshak Hatchery acts as a gene bank to preserve the North Fork Clearwater River “B-run” steelhead population, which no longer has access to historical habitat due to construction of Dworshak Dam. During the Status Review, NOAA Fisheries’ assessment of the effects of artificial propagation concluded that these hatchery programs collectively do not substantially reduce the extinction risk of the ESU in-total (NMFS 2004b). Snake River basin hatchery programs may be providing some benefit to the local target, but only the Dworshak-based programs have appreciably benefited the total number of adult spawners. The Little Sheep Hatchery program is contributing to total abundance in the Imnaha River but has not contributed

⁴ B-run steelhead have a 2-year ocean residence and larger body size and are believed to be produced only in the Clearwater, Middle Fork Salmon, and South Fork Salmon rivers.

to increased natural productivity. The Tucannon and East Fork Salmon river programs were only recently initiated and have yet to produce appreciable adult returns. Thus, the overall contribution of the hatchery programs in reducing risks to ESU abundance is small, and the contribution of ESU hatchery programs to the productivity of the ESU in-total is uncertain. Most returning Snake River basin hatchery steelhead are collected at hatchery weirs or have access to unproductive mainstem habitats, limiting potential contributions to the productivity of the entire ESU. The artificial propagation programs affect only a small portion of the ESU's spatial distribution and confer only slight benefits to ESU spatial structure. Large steelhead programs not considered to be part of the ESU occur in the mainstem Snake, Grande Ronde, and Salmon rivers and may adversely affect ESU diversity. These out-of-ESU programs are currently undergoing review to determine the level of isolation between the natural and hatchery stocks and to define what reforms may be needed. Collectively, artificial propagation programs in the ESU provide a slight beneficial effect to ESU abundance and spatial structure but have neutral or uncertain effects on ESU productivity and diversity.

4.3.6.4 Recent Dam Counts and Returns to the Spawning Grounds

The lack of information on adult spawning escapement to many tributary production areas makes it difficult to quantitatively assess the viability of the SR steelhead ESU. Estimates of annual returns are limited to estimates of aggregate numbers over Lower Granite Dam and spawner estimates for the Tucannon, Grande Ronde, and Imnaha rivers. Cooney (2004) reported continuing high returns of natural-origin SR steelhead (both A- and B-run fish) during 2002 and 2003 compared to those observed during much of the 1990s. In their preliminary report, Fisher and Hinrichsen (2004) estimated that the geometric mean of the natural-origin run was 37,784 during 2001-2003, a 253% increase over the 1996-2000 period (10,694 steelhead). The slope of the population trend increased 9.3% (from 1.00 to 1.10) when the counts for 2001-2003 were added to the 1990-2000 data series. These data indicate that, at least in the short term, the natural-origin run has been increasing.

4.3.7 UCR Steelhead

4.3.7.1 ESU Structure

The Interior TRT (TRT 2003) identified four historical, demographically independent populations in a single major population group in this ESU (Appendix B, Figure B.7). As described above for UCR spring chinook, the construction of Grand Coulee Dam in 1939 blocked access to over 50% of the river miles formerly available to UCR steelhead (NRC 1996). Tributaries in this blocked area may have supported one or more populations, but the lack of data on distribution and genetic makeup made it impossible for the Interior TRT to make a definitive determination.

The UCR steelhead ESU includes all naturally spawned populations of steelhead in streams in the Columbia River basin upstream from the Yakima River in Washington to the U.S.-Canada border (62 FR 43937; August 18, 1997).

NOAA Fisheries' June 14, 2004 listing proposal did not resolve the ESU membership of native resident populations that are above recent (usually man-made) impassable barriers but below natural barriers. It was provisionally proposed that these resident populations not be considered part of the revised UCR steelhead ESU, until such time as significant scientific information becomes available, thereby affording a case-by-case evaluation of their ESU relationships.

4.3.7.2 The BRT Findings

The BRT (2003) was concerned about the general lack of detailed information regarding the productivity of natural populations. The extremely low replacement rate of naturally spawning fish (0.25-0.30 at the time of the last status review in 1998) does not appear to have improved appreciably. The predominance of hatchery-origin natural spawners (approximately 70 to 90% of adult returns) is a significant source of concern for the diversity of the ESU and generates uncertainty about long-term trends in natural abundance and productivity. The natural component of the anadromous run over Priest Rapids Dam has increased from an average of 1,040 (1992-1996) to 2,200 (1997-2001). This pattern, however, is not consistent for other production areas within the ESU. The mean proportion of natural-origin spawners declined by 10% from 1992-1996 to 1997-2001. For many BRT members, the presence of relatively numerous resident fish reduced risks to ESU abundance but provided an uncertain contribution to ESU productivity, spatial structure, and diversity (NMFS 2003b; 2004a). The BRT found high risk for productivity and comparatively lower risk for abundance, diversity, and spatial structure.

4.3.7.3 2004 Status Review

In its Status Review, NOAA Fisheries reported that the last 2–3 years (through 2001) had seen an encouraging increase in the number of naturally produced fish in the UCR steelhead ESU. The 1996–2001 average aggregate return through the Priest Rapids Dam fish ladder (just below the upper Columbia steelhead production areas) was approximately 12,900 total adults, compared to 7,800 adults for 1992–1996. However, the recent 5-year mean abundances (through 2001) for naturally spawned populations in this ESU were 14 to 30% of their interim recovery target abundance levels.

Six artificial propagation programs that produce hatchery steelhead are considered to be part of the UCR steelhead ESU. These programs are intended to contribute to the recovery of the ESU by increasing the abundance of natural spawners, increasing spatial distribution, and improving local adaptation and diversity (particularly with respect to the Wenatchee River steelhead). Research projects to investigate the spawner productivity of hatchery-reared fish are being developed. Some of the hatchery-reared steelhead adults that return to the basin may be in excess of needs of the naturally spawning population in years when survival is high, potentially posing a risk to the natural-origin component of the ESU. The artificial propagation programs included in this ESU adhere to strict protocols for the collection, rearing, maintenance, and mating of the captive brood populations. Genetic evidence suggests that these programs remain closely related to the naturally spawned populations and maintain local genetic distinctiveness of populations within the ESU. Habitat Conservation Plans (HCPs) with the Chelan and Douglas Public Utility Districts and binding mitigation agreements ensure that these programs will have secure funding and will therefore continue into the future. These hatchery programs have undergone ESA Section 7 consultation to ensure that they do not jeopardize the recovery of the ESU and have

received ESA Section 10 permits for production through 2007. Annual reports and other specific information reporting requirements are used to ensure that the terms and conditions specified by NOAA Fisheries are followed. These programs, through adherence to best professional practices, have not experienced disease outbreaks or other catastrophic losses.

During the Status Review, NOAA Fisheries' assessment of the effects of artificial propagation concluded that hatchery programs collectively mitigate the immediacy of extinction risk for the UCR steelhead ESU in-total in the short term, but the contributions of these programs to the long-term survival and recovery of the species is uncertain (NMFS 2004b). The ESU hatchery programs substantially increase total ESU returns, particularly in the Methow basin, where hatchery-origin fish make up an average of 92% of all returns. The contribution of hatchery programs to the abundance of naturally spawning fish is uncertain, as is their contribution to the productivity of the ESU in-total. However, the presence of large numbers of hatchery-origin steelhead in excess of both broodstock needs and available spawning habitat capacity may decrease the productivity of the ESU. With increasing ESU abundance in recent years, naturally spawning, hatchery-origin fish have expanded into unoccupied spawning areas. Collectively, artificial propagation programs benefit ESU abundance and spatial structure but have neutral or uncertain effects on ESU productivity and diversity.

4.3.7.4 Recent Dam Counts and Returns to the Spawning Grounds

Fisher and Hinrichsen's (2004) preliminary estimate of the geometric mean of natural-origin UCR steelhead was 3,643 during 2001-2003 compared to 1,146 in 1996-2000, a 218% increase. The slope of the natural-origin population trend increased 9.2% (from 0.97 to 1.06,) when the data for 2001-2003 were added to the 1990-2000 series, reversing the decline and indicating, at least in the short term, that the run size has been increasing.

4.3.8 MCR Steelhead

4.3.8.1 ESU Structure

The Interior TRT (TRT 2003) identified 15 populations in four major population groups (Cascades Eastern Slopes Tributaries, John Day River, the Walla Walla and Umatilla rivers, and the Yakima River) and one unaffiliated independent population (Rock Creek) in this ESU (Appendix B, Figure B.8). There are two extinct populations in the Cascades Eastern Slope MPG, the White Salmon and Deschutes River above Pelton Dam.

The MCR steelhead ESU includes all naturally spawned populations of steelhead in streams from above the Wind River in Washington and the Hood River in Oregon (exclusive), upstream to and including the Yakima River in Washington, excluding steelhead from the Snake River basin (64 FR 14517; March 25, 1999).

NOAA Fisheries' June 14, 2004 listing proposal did not resolve the ESU membership of native resident populations that are above recent (usually man-made) impassable barriers but below natural barriers. It was provisionally proposed that these resident populations not be considered part of the revised MCR steelhead ESU until such time as significant scientific information becomes available, thereby affording a case-by-case evaluation of their ESU relationships.

4.3.8.2 The BRT Findings

The continued low number of natural returns to the Yakima River (10% of the interim recovery target abundance level, for a subbasin that was a major historical production center for the ESU) generated concern in the BRT. However, steelhead remain well distributed in the majority of subbasins in the ESU. The presence of substantial numbers of out-of-basin (and largely out-of-ESU) natural spawners in the Deschutes River raised substantial concern regarding the genetic integrity and productivity of the native Deschutes population. The extent to which this straying is a historical natural phenomenon is unknown. The cool Deschutes River temperatures may attract fish migrating in the comparatively warm Columbia River, inducing high stray rates. The BRT noted a particular difficulty in evaluating the contribution of resident fish to ESU-level extinction risk. Several sources indicate that resident fish are very common in the ESU and may greatly outnumber anadromous fish. The BRT concluded that the relatively abundant and widely distributed resident fish in the ESU reduce risks to overall ESU abundance but provide an uncertain contribution to ESU productivity, spatial structure, and diversity (NMFS 2003b; 2004a).

4.3.8.3 2004 Status Review

In its Status Review, NOAA Fisheries noted that the abundance of natural populations in the MCR steelhead ESU increased substantially in 2001 over the previous 5 years. The Deschutes and Upper John Day Rivers had recent 5-year mean abundance levels in excess of their respective interim recovery target abundance levels (NMFS, 2002). Due to an uncertain proportion of out-of-ESU strays in the Deschutes River, the recent increases in this population were difficult to interpret.

There are seven hatchery steelhead programs considered to be part of the MCR steelhead ESU. These programs propagate steelhead in three of 16 ESU populations and improve kelt (post-spawned steelhead) survival in one population. There are no artificial programs producing the winter-run life history in the Klickitat River and Fifteenmile Creek populations. All of the ESU hatchery programs are designed to produce fish for harvest, although two are also implemented to augment the naturally spawning populations in the basins where the fish are released.

During the Status Review, NOAA Fisheries' assessment of the effects of artificial propagation on ESU extinction risk concluded that these hatchery programs collectively do not substantially reduce the extinction risk of the ESU in-total (NMFS 2004b). ESU hatchery programs may provide a slight benefit to ESU abundance. Artificial propagation increases total ESU abundance, principally in the Umatilla and Deschutes rivers. The kelt reconditioning efforts in the Yakima River do not augment natural abundance but do benefit the survival of the natural populations. The Touchet River Hatchery program has only recently been established, and its contribution to ESU viability is uncertain. The contribution of ESU hatchery programs to the productivity of the three target populations and the ESU in-total is uncertain. The hatchery programs affect a small proportion of the ESU, providing a negligible contribution to ESU spatial structure. Overall, the impacts to ESU diversity are neutral. Collectively, artificial propagation programs in the ESU provide a slight beneficial effect to ESU abundance but have neutral or uncertain effects on ESU productivity, spatial structure, and diversity.

4.3.8.4 Recent Dam Counts and Returns to the Spawning Grounds

In their preliminary report, Fisher and Hinrichsen (2004) estimated a geometric mean of natural-origin MCR steelhead equal to 17,553 during 2001-2002 compared to 7,228 in 1996-2000, a 143% increase. The slope of the population trend for natural-origin fish increased 6.2% (from 0.99 to 1.05) when the data for 2001-2002 were added to the 1990-2000 series, reversing the decline and indicating that, at least in the short run, the natural-origin population has been increasing..

4.3.9 UWR Steelhead

4.3.9.1 ESU Structure

The UWR steelhead ESU includes all naturally spawned populations of winter-run steelhead in the Willamette River in Oregon and its tributaries upstream from Willamette Falls to the Calapooia River (inclusive) (64 FR 14517; March 25, 1999). The W/LC TRT (McElhany *et al.* 2004) identified four extant, demographically independent populations in one major population group (Appendix B, Figure B.9). NOAA Fisheries' June 14, 2004 listing proposal did not resolve the ESU membership of native resident populations that are above recent (usually man-made) impassable barriers but below natural barriers. It was provisionally proposed that these resident populations not be considered part of the revised UWR steelhead ESU, until such time as significant scientific information becomes available to afford a case-by-case evaluation of their ESU relationships.

This ESU does not include any artificially propagated steelhead stocks that reside within the historical geographic range of the ESU. Hatchery summer steelhead occur in the Willamette basin but are an out-of-basin stock that is not included in the ESU.

4.3.9.2 The BRT Findings

The BRT considered the cessation of the “early” winter-run hatchery program a positive sign for ESU diversity risk but remained concerned that releases of non-native summer steelhead continue. Because coastal cutthroat trout are dominant in the basin, resident steelhead are not as abundant or widespread here as in the inland proposed steelhead ESUs. The BRT did not consider resident fish to reduce risks to ESU abundance, and their contribution to ESU productivity, spatial structure, and diversity is uncertain (NMFS 2003b; 2004a).

The BRT found moderate risks for each of the VSP categories.

4.3.9.3 2004 Status Review

In its status review, NOAA Fisheries noted that approximately one-third of the LCR steelhead ESU's historically accessible spawning habitat is now blocked. Notwithstanding the lost spawning habitat, the ESU continues to be spatially well distributed, occupying each of the four major subbasins (the Molalla, North Santiam, South Santiam, and Calapooia rivers). There was some uncertainty about the historical occurrence of steelhead in drainages of the Oregon Coastal Range. Coastal cutthroat trout is a dominant species in the Willamette basin, and thus steelhead

are not expected to have been as widespread in this ESU as they are east of the Cascade Mountains.

4.3.9.4 Recent Dam Counts and Returns to the Spawning Grounds

In their preliminary report, Fisher and Hinrichsen (2004) estimated a geometric mean of natural-origin UWR steelhead at Willamette Falls equal to 9,541 during 2001-2004 compared to 3,961 in 1996-2000, a 141% increase. The slope of the population trend increased 10.4% (from 0.93 to 1.02) when the data for 2001-2004 were added to the 1990-2000 series, reversing the decline and indicating that, at least in the short run, the natural-origin population has been increasing.

4.3.10 LCR Steelhead

4.3.10.1 ESU Structure

The LCR steelhead ESU includes all naturally spawned populations of steelhead in streams and tributaries to the Columbia River between the Cowlitz and Wind rivers in Washington (inclusive) and the Willamette and Hood rivers in Oregon (inclusive). Excluded are steelhead in the upper Willamette River basin above Willamette Falls and steelhead from the Little and Big White Salmon rivers in Washington (62 FR 43937; August 18, 1997). The W/LC TRT (McElhany *et al.* 2004) identified a total of 20 extant, demographically independent populations in four major population groups: Cascade Winter-run, Cascade Summer-run, Gorge Winter-run, and Gorge Summer-run in this ESU (Appendix B, Figure B.10).

NOAA Fisheries' June 14, 2004 listing proposal did not resolve the ESU membership of native resident populations that are above recent (usually man-made) impassable barriers but below natural barriers. It was provisionally proposed that these resident populations not be considered part of the revised LCR steelhead ESU until such time as significant scientific information becomes available to afford a case-by-case evaluation of their ESU relationships. The presence of four major population groups in this ESU makes it is less likely that any single group is significant for this ESU's survival and recovery, compared to ESUs with fewer major population groups.

4.3.10.2 The BRT Findings

Approximately 35% of historical habitat has been lost in this ESU due to the construction of dams or other impassable barriers, but the ESU exhibits a broad spatial distribution in a variety of watersheds and habitat types. The BRT was particularly concerned about the impact on ESU diversity of the high proportion of hatchery-origin spawners in the ESU, the disproportionate declines in the summer steelhead life history, and the release of nonnative hatchery summer steelhead in the Cowlitz, Toutle, Sandy, Lewis, Elochoman, Kalama, Wind, and Clackamas rivers. Resident fish are not as abundant in this ESU as they are in the proposed steelhead ESUs. The BRT did not consider resident fish to reduce risks to ESU abundance, and their contribution to ESU productivity, spatial structure, and diversity is uncertain (NMFS 2003b; 2004a).

The BRT found moderate risks in each of the VSP categories.

4.3.10.3 2004 Status Review

In its Status Review, NOAA Fisheries noted that some anadromous populations in the LCR steelhead ESU, particularly summer-run steelhead populations, had shown encouraging increases in abundance in the 2 to 3 years ending 2001. However, population abundance levels remained small (no population had a recent 5-year mean abundance greater than 750 spawners).

There are 10 artificial propagation programs releasing hatchery steelhead that are considered to be part of the LCR steelhead ESU. All of these programs are designed to produce fish for harvest, but several are also implemented to augment the natural spawning populations in the basins where the fish are released. Four of these programs are part of research activities to determine the effects of artificial propagation programs that use naturally produced steelhead for broodstock in an attempt to minimize the genetic effects of returning hatchery adults that spawn naturally. One of these programs, the Cowlitz River late-run winter steelhead program, is also producing fish for release into the upper Cowlitz River Basin in an attempt to reestablish a natural spawning population above Cowlitz Falls Dam.

NOAA Fisheries concluded that these hatchery programs collectively do not substantially reduce the extinction risk of the ESU in-total (NMFS 2004b). The hatchery programs have reduced risks to ESU abundance by increasing total ESU abundance and the abundance of fish spawning naturally in the ESU. The contribution of ESU hatchery programs to the productivity of the ESU in-total is uncertain. It is also uncertain if steelhead reintroduced into the Upper Cowlitz River will be viable in the foreseeable future, because outmigrant survival appears to be quite low. As noted by the BRT, out-of-ESU hatchery programs have negatively impacted ESU productivity. The within-ESU hatchery programs provide a slight decrease in risks to ESU spatial structure, principally through the re-introduction of steelhead into the Upper Cowlitz River basin. The eventual success of these reintroduction efforts, however, is uncertain. Collectively, artificial propagation programs in the ESU provide a slight beneficial effect on ESU abundance, spatial structure, and diversity but uncertain effects on ESU productivity.

4.3.10.4 Recent Dam Counts and Returns to the Spawning Grounds

In their preliminary report, Fisher and Hinrichsen (2004) estimated that the aggregate abundance of LCR steelhead was equal to 4,429 during 2001 compared to 6,333 during the period 1996-2000, a 30% decrease in abundance. The slope of the aggregate population trend declined by 0.8% (from 0.93 to 0.92) when the 2001 count was added to the 1990-2000 data series.

4.3.11 CR Chum Salmon

4.3.11.1 ESU Structure

The W/LC TRT (McElhany *et al.* 2004) identified a total of eight extant, demographically independent populations in three major population groups in this ESU: Coastal, Cascade, and Gorge (Appendix B, Figure B.11). Approximately 90% of the historical populations in the Columbia River chum ESU are extirpated or nearly so, and the Gorge population group was established by inferring that the approximately 100 adult chum salmon that ascend the Bonneville Dam fish ladders each year are spawning upstream. However, the Washington

Department of Fish & Wildlife (WDFW) found only one and two carcasses in its 2002 and 2003 spawning ground surveys in the Gorge area, respectively, and its radio-tag data indicate that at least some fish fall back downstream (Ehlke and Keller 2003). The Smolt Monitoring Program has no record of juvenile chum salmon at Bonneville Dam.

4.3.11.2 The BRT Findings

The loss of off-channel habitats and the extirpation of approximately 17 historical populations increase the ESU's vulnerability to environmental variability and catastrophic events. The populations that remain are low in abundance and have limited distribution and poor connectivity. The BRT found high risks for each of the VSP categories, particularly for the ESU's spatial structure and diversity.

4.3.11.3 2004 Status Review

In its Status Review, NOAA Fisheries noted that approximately 90% of the historical populations in the CR chum salmon ESU are extirpated or nearly so. During the 1980s and 1990s, the combined abundance of natural spawners for the Lower and Upper Columbia River Gorge, Washougal, Grays River populations was below 4,000 adults. In 2002, however, the abundance of natural spawners exhibited a substantial increase at several locations. The preliminary estimate of natural spawners in 2002 was approximately 20,000 adults. The cause of this dramatic increase in abundance is unknown. Improved ocean conditions, the initiation of a supplementation program the Grays River, improved flow management at Bonneville Dam, favorable freshwater conditions, and increased survey sampling effort may have contributed to the elevated 2002 abundance. However, long- and short-term productivity trends for ESU populations were at or below replacement. The loss of off-channel habitats and the extirpation of approximately 17 historical populations increase the ESU's vulnerability to environmental variability and catastrophic events. The populations that remain are low in abundance, have limited distribution and poor connectivity.

There are three artificial propagation programs producing chum salmon considered to be part of the Columbia River chum ESU. These are conservation programs designed to support natural productivity. The Washougal Hatchery artificial propagation program provides artificially propagated chum salmon for re-introduction into recently restored habitat in Duncan Creek, Washington. This program also provides a safety net for the naturally spawning population in the mainstem Columbia River below Bonneville Dam. That population can access only a portion of spawning habitat during low-flow conditions. The other two programs are designed to augment natural production in the Grays River and the Chinook River in Washington. All these programs use naturally produced adults for broodstock. These programs were only recently established (1998-2002), with the first hatchery chum returning in 2002.

NOAA Fisheries' assessment of the effects of artificial propagation on ESU extinction risk concluded that these hatchery programs collectively do not substantially reduce the extinction risk of the ESU in-total (NMFS 2004b). They have only recently been initiated and are just beginning to provide benefits to ESU abundance. The contribution of ESU hatchery programs to the productivity of the ESU in-total is uncertain. The Sea Resources and Washougal Hatchery programs have begun to provide benefits to ESU spatial structure through reintroductions of

chum salmon into restored habitats in the Chinook River and Duncan Creek, respectively. These three programs have a neutral effect on ESU diversity. Collectively, artificial propagation programs in the ESU provide a slight beneficial effect to ESU abundance and spatial structure but have neutral or uncertain effects on ESU productivity and diversity.

4.3.11.4 Recent Returns to the Spawning Grounds

In their preliminary report, Fisher and Hinrichsen (2004) estimated a geometric mean of the aggregate number of CR chum salmon in two index areas (Grays River and Hamilton and Hardy creeks) equal to 1,776 during 2001-2003 compared to 2,114 in 1996-2000, a 16% decrease. The slope of the aggregate population trend decreased 1.5% (from 1.02 to 1.00) when the data for 2001-2003 were added to the 1990-2000 series.

4.3.12 SR Sockeye Salmon

4.3.12.1 ESU Structure

Anadromous sockeye were once abundant in a variety of lakes throughout the Snake River basin: Alturas, Pettit, Redfish, Stanley, and Yellowbelly in the Sawtooth Valley and in Wallowa, Payette, and Warm lakes (Appendix B, Figure B.12), but the only remaining population resides in Redfish Lake. Beginning in the late nineteenth century, anadromous sockeye salmon were affected by heavy harvest pressures, unscreened irrigation diversions, and dam construction (TRT 2003). In addition, in the 1950s and 1960s, the Idaho Department of Fish & Game (IDFG) actively eradicated sockeye salmon from some locations.

The SR sockeye ESU includes populations of anadromous sockeye salmon from the Snake River basin in Idaho, though extant populations occur only in the Stanley Basin (56 FR 58619; November 20, 1991). The ESU also includes residual sockeye salmon in Idaho's Redfish Lake, as well as one captive propagation hatchery program. Artificially propagated sockeye salmon from the Redfish Lake Captive Broodstock Program are considered part of this ESU. NOAA Fisheries has determined that this artificially propagated stock is genetically no more than moderately divergent from the natural population (NMFS 2004b). Subsequent to the 1991 listing determination for SR sockeye, a "residual" form of Snake River sockeye (hereafter "residuals") was identified. The residuals often occur together with anadromous sockeye salmon and exhibit similar behavior in the timing and location of spawning. Residuals are thought to be the progeny of anadromous sockeye salmon but are generally nonanadromous. In 1993, NMFS determined that the residual population of Snake River sockeye that exists in Redfish Lake is substantially reproductively isolated from kokanee (i.e., nonanadromous populations of *O. nerka* that become resident in lake environments over long periods of time), represents an important component in the evolutionary legacy of the biological species, and thus merits inclusion in the SR sockeye ESU.

Only 16 naturally produced adults have returned to Redfish Lake since the Snake River sockeye ESU was listed as an endangered species in 1991. All 16 fish were taken into the Redfish Lake Captive Broodstock Program, which was initiated as an emergency measure in 1991. The return of over 250 adults in 2000 was encouraging; however, subsequent returns from the captive

program in 2001 and 2002 have been fewer than 30 fish. The BRT found extremely high risks for all four VSP categories.

4.3.12.2 The BRT Findings and the 2004 Status Review

There is a single artificial propagation program producing SR sockeye salmon in the Snake River basin. The Redfish Lake sockeye salmon stock was originally founded by collecting the entire anadromous adult return of 16 fish between 1990 and 1997, the collection of a small number of residual sockeye salmon, and the collection of a few hundred smolts migrating from Redfish Lake. These fish were put into a Captive Broodstock program as an emergency measure to prevent extinction of this ESU. Since 1997, nearly 400 hatchery-origin anadromous sockeye adults have returned to the Stanley Basin from juveniles released by the program. Redfish Lake sockeye salmon have also been reintroduced into Alturas and Pettit lakes using progeny from the captive broodstock program. The captive broodstock program presently consists of several hundred fish of different year classes maintained at facilities in Eagle, Idaho and Manchester, Washington.

NOAA Fisheries' assessment of the effects of artificial propagation on ESU extinction risk concluded that the Redfish Lake Captive Broodstock Program does not substantially reduce the extinction risk of the ESU in-total (NMFS 2004b). The Artificial Propagation Evaluation Workshop noted that the Redfish Lake Captive Broodstock Program has likely prevented extinction of the ESU. This program has increased the total number of anadromous adults, attempted to increase the number of lakes in which sockeye salmon are present in the upper Salmon River (Stanley Basin), and preserved what genetic diversity remains in the ESU. Although the program has increased the number of anadromous adults in some years, it has yet to produce consistent returns, and the long-term effects of captive rearing are unknown. The consideration of artificial propagation does not substantially mitigate the BRT's assessment of extreme risks to ESU abundance, productivity, spatial structure, and diversity.

4.3.12.3 Recent Dam Counts and Returns to the Spawning Grounds

In their preliminary report, Fisher and Hinrichsen (2004) estimated a geometric mean of aggregate numbers of SR sockeye salmon equal to 14 during 2001-2004 compared to 4 in 1996-2000, a 211% increase. However, because returns were higher in 2001 and 2002 than in 2003, the slope of the aggregate population trend decreased 3.7% (from 1.26 to 1.22) when the data for 2001-2004 were added to the 1990-2000 series.

4.3.13 LCR Coho Salmon

4.3.13.1 ESU Structure

The W/LC TRT (McElhany *et al.* 2004) identified a total of 21 extant, demographically independent populations in three major population groups in this ESU: Coastal, Cascade, and Gorge (Appendix B, Figure B-13). There are only two extant populations in the LCR coho ESU with appreciable natural productivity, the Clackamas and Sandy river populations, down from an estimated 23 historical populations in the ESU.

4.3.13.2 The BRT Findings

Short- and long-term trends in productivity are below replacement. Approximately 40% of historical habitat is currently inaccessible, which restricts the number of areas that might support natural productivity and further increases the ESU's vulnerability to environmental variability and catastrophic events. The extreme loss of naturally spawning populations, the low abundance of extant populations, diminished diversity, and fragmentation and isolation of the remaining naturally produced fish confer considerable risks on the ESU. The lack of naturally produced spawners in this ESU is contrasted by the very large number of hatchery-produced adults. The abundance of hatchery coho returning to the Lower Columbia River in 2001 and 2002 exceeded one million and 600,000 fish, respectively. The BRT expressed concern that the magnitude of hatchery production continues to pose significant genetic and ecological threats to the extant natural populations in the ESU. However, these hatchery stocks collectively represent a significant portion of the ESU's remaining genetic resources. The 21 hatchery stocks considered to be part of the ESU, if appropriately managed, may prove essential to the restoration of more widespread naturally spawning populations. The BRT found extremely high risks for all VSP categories.

4.3.13.3 2004 Status Review

There are only two extant populations in the LCR coho salmon ESU with appreciable natural production (the Clackamas and Sandy River populations), from an estimated 23 historical populations in the ESU. Although adult returns in 2000 and 2001 for the Clackamas and Sandy River populations exhibited moderate increases, the recent 5-year mean of natural-origin spawners for both populations represented less than 1,500 adults. The Sandy River population had exhibited recruitment failure in 5 of 10 years (i.e., 1992-2001), and had exhibited a poor response to reductions in harvest. During the 1980s and 1990s natural spawners were not observed in lower basin tributaries. Coincident with the 2000–2001 abundance increases in the Sandy and Clackamas populations, a small number of coho spawners of unknown origin have been surveyed in some of these areas. Short- and long-term trends in productivity are below replacement.

Approximately 40% of historical habitat is currently inaccessible, which restricts the number of areas that might support natural production, and further increases the ESU's vulnerability to environmental variability and catastrophic events. The extreme loss of naturally spawning populations, the low abundance of extant populations, diminished diversity, and fragmentation and isolation of the remaining naturally-produced fish confer considerable risks. The paucity of natural-origin spawners is contrasted by the very large number of hatchery-produced adults. The numbers of hatchery coho returning to the lower Columbia River in 2001 and 2002 exceeded one million and 600,000 fish, respectively.

All of the 21 hatchery programs included in the LCR coho ESU are designed to produce fish for harvest, and two of the smaller programs are also designed to augment the natural spawning populations in the Lewis River basin. Artificial propagation in this ESU continues to represent a threat to the genetic, ecological, and behavioral diversity of the ESU. Past artificial propagation efforts imported out-of-ESU fish for broodstock, generally did not mark hatchery fish, mixed broodstocks derived from different local populations, and transplanted stocks among basins

throughout the ESU. The result is that the hatchery stocks considered to be part of the ESU represent a homogenization of populations. Several of these risks have recently begun to be addressed by improvements in hatchery practices. Out-of-ESU broodstock is no longer used, and near 100% marking of hatchery fish is employed to improve monitoring and evaluation of broodstock and (hatchery- and natural-origin) returns. However, many of the within-ESU hatchery programs do not adhere to best hatchery practices. Eggs are often transferred among basins in an effort to meet individual program goals, further compromising ESU spatial structure and diversity. Programs may use broodstock that does not reflect what was historically present in a given basin, limiting the potential for artificial propagation to establish locally adapted naturally spawning populations. Many programs lack Hatchery and Genetic Management Plans (HGMPs) that establish escapement goals appropriate for the natural capacity of each basin and that identify goals for the incorporation of natural-origin fish into the broodstock.

During the Status Review, NOAA Fisheries' assessment of the effects of artificial propagation on ESU extinction risk concluded that hatchery programs collectively mitigate the immediacy of extinction risk for the LCR coho ESU in-total in the short term, but these programs do not substantially reduce the extinction risk of the ESU in the foreseeable future (NMFS 2004b). At present, within-ESU hatchery programs significantly increase the abundance of the ESU in-total. Without adequate long-term monitoring, the contribution of ESU hatchery programs to the productivity of the ESU in-total is uncertain. The hatchery programs are widely distributed throughout the lower Columbia River, reducing the spatial distribution of risk from catastrophic events.

Additionally, reintroduction programs in the Upper Cowlitz River may provide additional reduction of ESU spatial structure risks. As mentioned above, the majority of the ESU's genetic diversity exists in the hatchery programs. Although these programs have the potential of preserving historical local adaptation and behavioral and ecological diversity, the manner in which these potential genetic resources are presently being managed poses significant risks to the diversity of the ESU in-total. At present, the LCR coho hatchery programs reduce risks to ESU abundance and spatial structure, provide uncertain benefits to ESU productivity, and pose risks to ESU diversity. Overall, artificial propagation mitigates the immediacy of ESU extinction risk in the short term but is of uncertain contribution in the long term.

Over the long term, reliance on the continued operation of these hatchery programs is risky (NMFS 2004b). Several LCR coho hatchery programs have been terminated, and there is the prospect of additional closures in the future. With each hatchery closure, any potential benefits to ESU abundance and spatial structure are reduced. Risks of operational failure, disease, and environmental catastrophes further complicate assessments of hatchery contributions over the long term. Additionally, the two extant naturally spawning populations in the ESU were described by the BRT as being "in danger of extinction." Accordingly, it is likely that the LCR coho ESU may exist in hatcheries only within the foreseeable future. It is uncertain whether these isolated hatchery programs can persist without the incorporation of natural-origin fish into the broodstock. Although there are examples of salmonid hatchery programs having been in operation for relatively long periods of time, these programs have not existed in complete isolation. Long-lived hatchery programs historically required infusions of wild fish in order to meet broodstock goals. The long-term sustainability of such isolated hatchery programs is

unknown. It is uncertain whether the Lower Columbia River coho isolated hatchery programs are capable of mitigating risks to ESU abundance and productivity into the foreseeable future. In isolation, these programs may also become more than moderately diverged from the evolutionary legacy of the ESU and hence no longer merit inclusion in the ESU. Under either circumstance, the ability of artificial propagation to buffer the immediacy of extinction risk over the long term is uncertain.

4.3.13.4 Recent Dam Counts and Returns to the Spawning Grounds

In their preliminary report, Fisher and Hinrichsen (2004) estimated a geometric mean of aggregate numbers of LCR coho salmon equal to 3,027 during 2001-2003 compared to 822 in 1996-2000, a 268% increase. The slope of the aggregate population trend increased 10.4% (from 0.92 to 1.02) when the data for 2001-2003 were added to the 1990-2000 series, reversing the decline and indicating that, at least in the short run, the aggregate run is increasing..